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Optical chirality and superchiral fields YIQIAO TANG, Department of Physics, Harvard University — A chiral object is any material body whose mirror image may not be superimposed on the original. Electromagnetic (EM) fields may be chiral too, with circularly polarized light as the paradigmatic example. We propose a measure of the local chirality of EM fields, which we call optical chirality. Optical chirality determines the degree of chiral asymmetry in the interaction of light with small molecules. We predict the existence of superchiral forms of light which show larger bias for exciting a single chiral enantiomer, in some regions of space, than does circularly polarized plane waves. We performed a conceptually simple experiment to probe the interaction of superchiral light with a chiral biperylene derivative. We selected this molecule for its strong intrinsic optical activity and fluorescence in the visible. The regions of enhanced chiral selectivity are too thin to detect by absorption, so we used fluorescence instead. We demonstrated experimentally a 12-fold enhancement in the chiral selectivity of superchiral fields for these chiral compounds. The demonstrated chiral enhancement is not a fundamental limit. Larger enhancement may be obtained at the expense of lower overall excitation rate. These results establish that optical chirality is a fundamental property of the electromagnetic field, with possible applications ranging from plasmonic sensors to absolute asymmetric synthesis.

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